REMARKS

Reconsideration of the present application is respectfully requested. In response to the final Office Action of October 28, 2005, the applicants submit claim amendments in which the independent claim incorporates the limitations of original pending claims 1 and 2, and independent claim 4 incorporates claims 4 and 5. In the previous submission applicants had amended claim 1 to incorporate claims 1 and 3 and 4 and 6. It should be evident that the present amendments do not raise issues or create search grounds that have not before been considered here. Accordingly, entry of these amendments should be deemed as proper.

Claims 1, 2, 4 and 5 stand rejected under 35 U.S.C. §103(a) as being unpatentable over applicant's admitted prior art (AAPA) in view of Yagi, U.S. Patent No. 6,036,084. Among the comments made by the examiner regarding Yagi and the invention set forth in the claims, perhaps the most pertinent to the claims as previously amended are the following:

> "Yagi teaches controlling the moisture content of the air using air to a predetermined value (col. 4, 11. 30-36). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the screen printing process of AAPA to utilize controlling the moisture content of the claimed range in order to limit the moisture absorption by the solder paste (see Yagi col. 1, 11. 50-65). In addition, it would have been obvious to one of ordinary skill in the art at the time of the invention to choose the instantly claimed ranges through process optimization, since it has been held that the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See In re Boesch, 205 USPQ 214 (CCPA 1980)."

The applicants respectfully disagree with the examiner's negative characterization of patentability. Submitted herewith as Exhibit "A" is Figure 1, which represents the results of experiments, conducted by the inventors to quantify the amount of moisture (in density) in an atmosphere during a priority employing a tin-zinc (Sn-Zn) containing solder paste. A horizontal line in Fig. 1 shows moisture (10 g/m^3) contained in the atmosphere, and the vertical line shows

continuously printable time (hr), that is, the time for maintaining the quality of printing for the solder paste containing a tin-zinc (Sn-Zn) system solder. As seen from Fig. 1, the value for continuously printable time changes rapidly when the moisture is about 10 g/m^3.

It should be observed that where moisture content is about 20 g/m^3 or greater, the continuously printable time is about 3 hours. However, continuously printable time increases rapidly, approaching 24 hours as the moisture content approaches 10 g/m^3, and continuously printable time reaches 24 hours when the moisture content is a little greater than 10 g/m^3. Note also that continuously printable time is in excess of 24 hours when the moisture is less than 10 g/m^3. Thus, continuously printable time that is equal to or in excess of 24 hours has technical significance because it enables the solder paste containing a tin-zinc (Sn-Zn) system solder to be used in a mass production line. Thus, the present demonstration evidencing a clear difference in the continuously printable time for moisture contents within and without the recited claim limitation of "equal to or less than $10/gm^3$", represents a substantial improvement in the present field that is not recognized by Yagi's merely general instruction concerning control of moisture content.

The present invention enables suppression of "an increase in the viscosity of the solder paste which is caused by the reaction of Zn in the tin-zinc (Sn-Zn) system solder". See, e.g. the specification at page 5, line 24; page 6, line 5; page 7, line 23; and page 8, line 7. The inventors of the present invention studied the reaction of Zn, that is an active metal, in the above-described reaction. The inventors found that the reaction of the flux component with Zn, which undergoes change when moistened, continues for a short period of time, and accordingly, the viscosity of the solder paste containing a tin-zinc (Sn-Zn) system solder increases. The inventors also found that this lowers the coating property of the solder paste on the printing mask and causes the

solder paste to attach to the squeegee. Thus, after a few hours after starting the printing process, the solder paste would fail to sufficiently fill the apertures of the printing mask which, in turn, may cause a failure in the printing. The increasing viscosity of the solder paste, again caused by the reaction of Zn, is particular to the tin-zinc (Sn-Zn) solder system containing Zn as an active metal. It is important to consider that because moisture levels in the present claimed solder paste printing method is maintained at 10 g/m^3, the claimed method delays degradation of the solder paste for up to approximately 24 hours, rendering solder paste usable in mass production lines.

The cited Yagi reference discloses screen printing of a printing paste, such as a solder paste, on a board in a dry air atmosphere which has a humidity of 20% or less for preventing the printing paste from absorbing moisture during the screen printing. Yagi indicates that solder balls are generated in a reflowing process (see column 7, lines 16-25), exemplifying the disadvantage occurring when the printing paste absorbs moisture. In any event, Yagi does not teach or suggest an increase in the viscosity of the solder paste which is caused by the reaction of Zn in the tin-zinc (Sn-Zn) system solder, for the simple reason that Yagi does not describe a tin-zinc (Sn-Zn) system solder.

Yagi is silent on maintaining moisture contained in the atmosphere surrounding a solder paste containing a tin-zinc (Sn-Zn) system solder to level that is equal to or less than 10 g/m^3. Furthermore, Yagi's failure to discuss tin-zinc (Sn-Zn) system solder means that it offers the skilled artisan no insight into the problems presented by this specific solder paste. Thus, Yagi offers no teaching regarding "suppress an increase in the viscosity of the solder paste which is caused by the reaction of Zn in the tin-zinc (Sn-Zn) system solder". It is particularly important that Yagi does not teach or suggest the significance of maintaining no time to a value equal to or less than 10 g/m^3. Nothing in Yagi suggests the rather significant improvement in the

continuously printable time that is realized when moisture is maintained in this range. Also, since Yagi teaches only general moisture control, it cannot be said to teach anything regarding the substantial difference between maintaining moisture equal to or to below 10 g/m^3, when compared to maintaining the value above 10 g/m^3.

The problem to be solved in the present invention is decisively different from that of Yagi. As described above, the present invention is suppresses the increase of the viscosity of the solder paste, caused by the reaction of Zn in the tin-zinc (Sn-Zn) system solder. It is obvious that this problem is not recognized in Yagi because Yagi describes nothing about the tin-zinc (Sn-Zn) system solder.

The present invention has the particular effect that it can extend the continuously printable time of the tin-zinc (Sn-Zn) system solder up to about 24 hours that is required for use in mass production. This effect according to the preset invention is outstanding because the continuously printable time rapidly changes between the inside and the outside of the numerical limit of "equal to or less than 10 g/m^3". This effect is entirely different from the effect according to the cited invention. Accordingly, the present invention aims at both improving an ability of successive printing and suppressing of the generation of solder balls by suppressing an increase in viscosity of the solder paste, whereas Yagi does not mention to suppress an increase in viscosity of the solder paste.

As to suppressing an increase in viscosity of the solder paste, the present invention provides an effect that "reaction of the flux of solder paste with the moisture in the surrounding atmosphere is made inactive during the solder paste printing process so as to suppress an increase in the viscosity of the flux." See specification at page 8, lines 8-11. As a result, "the rolling ability of solder paste during the printing process can be adequately maintained"

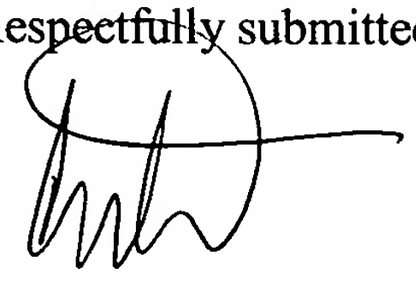
(specification at page 8, lines 11-13) and "attachment of solder paste to squeegee can be prevented, so that defective printing may be prevented from occurring" (specification at page 8, lines 13-15) and also "in the conventional printing process, although deterioration in the quality of the solder paste has occurred in approximately three hours after commencement of the printing process, according to the present invention, occurrence of deterioration in the solder paste quality can be prolonged to approximately 24 hours, so that life of solder paste can be lengthened." (specification at page 8, lines 16-22).

Regarding a factor of generation of the solder balls, Yagi describes "Nevertheless, in the art, past solder is printed on a board screen printing apparatus having an open air atmosphere in and a chip or chips are mounted on the board chip mounting apparatus having an open air atmosphere. Unfortunately, this causes either absorption of moisture by the flux ingredient of the paste solder or condensation or dewing of moisture on the applied paste solder during printing and chip mounting. This results in the increased generation of solder balls regardless of whether reflow soldering in conducted in a dry air atmosphere (see column 1, lines 53-62).

On the contrary, the present application describes "Further, during the printing process of the solder paste, when the material of the solder, especially the zinc (Zn), is oxidized by the reaction with an oxygen contained in the atmosphere, wettability of the solder material is degraded. As a result, many solder balls are generated during the mounting process of the electronic components." As can be understood from this, the factor of generation of the solder balls is considered in the present application in relation to the characteristic of tin-zinc (Sn-Zn) system solder.

Wherefore, based upon the foregoing, it is submitted that the claims are in condition of allowance and a relatively early reply to this paper would be appreciated.

Respectfully submitted,



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